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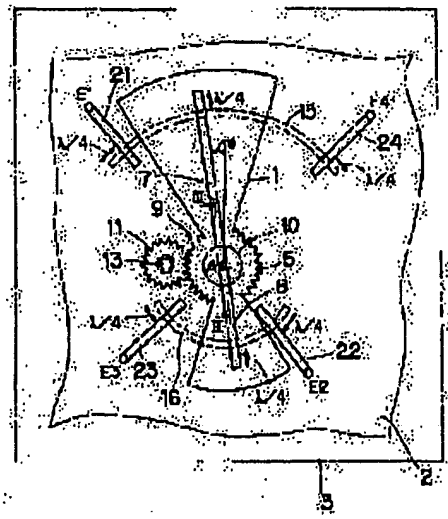
(54) DISTRIBUTION VARIABLE PHASE SHIFTER

(57)Abstract:
PURPOSE: To provide a distribution variable phase shifter which can distribute the electric power and then can continuously vary the phase of distributed signals in a simple and highly reliable constitution.
CONSTITUTION: A rotary substrate 1 can relatively turn to a fixed substrate 2 and is provided with input strip lines 7 and 8 to distribute the high frequency signals received through an input terminal A into two groups. Meanwhile the substrate 2 is provided with arc-shaped slot lines 15 and 16 of different radiuses, and the output strip lines 21, 22, 23 and 24 are connected to both ends of lines 15 and 16 respectively. The high frequency signals supplied through the terminal A are distributed to the output terminals E1-E4. When the substrate 1 is turned, the lengths of transmission lines led to the terminals E1-E4 from the terminal A are continuously varied. Therefore the phase shifted variable is continuously varied. Furthermore the signals of difference phases are taken out of the terminals E1-E4 and at the same time the phase differences can be varied among the signals in accordance with



turning of the substrate 1.

LEGAL STATUS

[Date of request for examination]

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[Date of requesting appeal against examiner's decision of rejection]

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NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The distribution adjustable phase shifter which has the 1st substrate and the 2nd substrate which are characterized by providing the following, and which can be rotated relatively [circumference / of a predetermined axis]. The 1st substrate of the above is the input edge prepared on the above-mentioned axis. They are n circular slot lines which have the input stripline of n (n= 1, 2, 3 and 4, ...) book which branched from this input edge, and are sharing the center on the above-mentioned predetermined axis while the 2nd substrate of the above is combined with n above-mentioned striplines, respectively. 2n output stripline combined with each ends of these n circular slot lines, respectively.

[Claim 2] n above-mentioned circular slot lines are distribution variable-phase machines according to claim 1 characterized by having a radius which is mutually different.

[Claim 3] For n above-mentioned circular slot lines, the ratio of a radius is 1:3:5. : ..... It

is the distribution adjustable phase shifter according to claim 2 characterized by being formed so that it may become : (2n-1).
[Claim 4] The distribution adjustable phase shifter according to claim 1 to 3 characterized by including further the rotary joint which combines between the above-mentioned input edge and feeders in the state of permitting relative rotation of the circumference of the above-mentioned predetermined axis.
[Claim 5] The distribution adjustable phase shifter according to claim 1 to 4 characterized by including further the rolling mechanism for rotating relatively [circumference / of the above-mentioned predetermined axis] the 1st substrate of the above, and the 2nd substrate, and the control unit for giving turning effort to this rolling mechanism.
[Claim 6] The distribution adjustable phase shifter according to claim 1 to 5 characterized by infixing the impedance converter in the above-mentioned input stripline, the above-mentioned output stripline, or the above-mentioned circular slot line.
[Claim 7] The distribution adjustable phase shifter according to claim 1 to 5 characterized by establishing an impedance matching circuit in the above-mentioned input edge.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the distribution adjustable phase shifter to which the phase of the distributed signal can be changed continuously while being able to perform power distribution of a RF signal. By using this distribution adjustable phase shifter, the beam tilt angle of the array antennas used for example, in a mobile communications base station can be changed electrically.
[0002]
[Description of the Prior Art] In order to change the beam tilt angle of array ANNATE, the feeder system which changes the length of the cable which supplies electric power to each array-antennas element in the RF signal distributed with the power distribution unit, and changed the phase distribution of the high frequency current to which electric power is supplied by array antennas by this is used.
[0003]
[Problem(s) to be Solved by the Invention] Although the amount of phase shifts of a RF signal will be set up with the length of a cable in such a feeder system, when it is going to

change the amount of phase shifts, a cable is removed from a connector, and it exchanges for the cable with which length is different, or the cable itself is shortened, and the complicated work of attaching a connector again is needed, for example. Especially, when a feeder system is installed in the outdoors, since water proofing is performed to a connector area, you also have to do each work of removal of the water-proofing section, and anchoring.

[0004] Moreover, in order to change the beam tilt angle of array antennas, the length of a cable is made the same and what infixed the phase shifter between a power distribution unit and array antennas is used. With this composition, if it is going to change a phase in a continuous or fine pitch, while many switches and cables will be needed and the size of a feeder system will become large, cost also increases. And since the above-mentioned switch has the Mechanical contact, it may start a poor contact by secular change, and has a possibility of producing an intermodulation and noise.

[0005] Then, the purpose of this invention is offering the distribution adjustable phase shifter to which the phase of the distributed signal can be changed continuously while it solves an above-mentioned technical technical problem and can distribute power by easy and reliable composition.

[0006]

[Means for Solving the Problem and its Function] The distribution adjustable phase shifter according to claim 1 for attaining the above-mentioned purpose It is the distribution adjustable phase shifter which has the 1st substrate and the 2nd substrate which can be rotated relatively [circumference / of a predetermined axis]. the 1st substrate of the above It has the input edge prepared on the above-mentioned axis, and the input stripline of n (n= 1, 2, 3 and 4, ...) book which branched from this input edge. the 2nd substrate of the above While being combined with n above-mentioned striplines, respectively, it is characterized by having n circular slot lines which are sharing the center on the above-mentioned predetermined axis, and 2n output stripline combined with each ends of these n circular slot lines, respectively.

[0007] According to this composition, if a RF signal is given to the input edge of the 1st substrate, after this RF signal is distributed to n input striplines, it will be given to n circular slot lines formed in the 2nd substrate, and will be further given to the output stripline combined with the ends of each circular slot line. By this, 2n of inputted RF signals will be distributed.

[0008] If the 1st substrate and the 2nd substrate are rotated relatively [circumference / of a predetermined axis], the transmission path length which results in an output stripline will change from an input edge corresponding to the rotated angle and the radius of a circular slot line. Since the amount of phase shifts of a RF signal is set up corresponding to this transmission path length, the amount of phase shifts can be continuously changed by rotating the 1st substrate and the 2nd substrate relatively.

[0009] A distribution adjustable phase shifter according to claim 2 is characterized by n above-mentioned circular slot lines having a mutually different radius. According to this composition, since n circular striplines have a mutually different radius, the change of the above-mentioned transmission path length accompanying relative rotation with the 1st substrate and the 2nd substrate differs for every output stripline. Therefore, the phase contrast between the signals taken out from 2n output stripline can be changed continuously.

[0010] For n above-mentioned circular slot lines, the ratio of a radius is [a distribution adjustable:phase shifter according to claim 3] 1:3:5. : ..... It is characterized by being formed so that it may become : (2n-1). According to this composition, the variation of the transmission path length from the input edge accompanying relative rotation of the 1st substrate and the 2nd substrate to each output stripline can be set up in the shape of a taper. That is, the RF signal given to the input edge can be distributed to 2n signal which has Taber-like phase contrast.

[0011] In addition, it is desirable to have the rotary joint which combines between the above-mentioned input edge and feeders in the state of permitting relative rotation of the circumference of the above-mentioned predetermined axis as indicated by the claim 4. Moreover, it is desirable to have a rolling mechanism for rotating relatively [circumference / of the above-mentioned predetermined axis] the 1st substrate of the above and the 2nd substrate and a control unit for giving turning effort to this rolling mechanism as indicated by the claim 5,

[0012] Furthermore, what is necessary is to infix an impedance converter in the above-mentioned input stripline, the above-mentioned output stripline, or the above-mentioned circular slot line, to establish an impedance matching circuit in (a claim 6) and the above-mentioned input edge (claim 7), or just to carry out, in order to adjust the impedance of an input edge and the outgoing end of the edge of an output stripline.

[0013]

[Example] Below, the example of this invention is explained in detail with reference to an accompanying drawing. Drawing 1 is the plan showing the composition of the distribution adjustable phase shifter of one example of this invention. This distribution adjustable phase shifter is equipped with the rotation substrate 1 as the 1st substrate, and the fixed substrate 2 as the 2nd substrate. It is attached so that the fixed substrate 2 may be fixed to the shielding case 3 shown by the imaginary line and the rotation substrate 1 can be freely rotated to the circumference of the predetermined axis 5 to the fixed substrate 2.

[0014] The rotation substrate 1 consists of insulators and the input striplines 7 and 8 prolonged in the direction which deserts an axis 5 are formed in the front face. Electric power is supplied to a RF signal by the input striplines 7 and 8 from the input edge A through the input section 10 prepared behind the fixed substrate 2. The conductor is not formed in the rear face of the rotation substrate 1. The rotation substrate 1 has the gearing section 9 around the axis 5. This gearing section 9 gears with the gearing 11 held free [rotation] to the fixed substrate 2, and is in it. The knob 13 as a control unit which projects out of a shielding case 3 is being fixed to the gearing 11, and the rotation substrate 1 can be rotated by rotating this knob 13. That is, the rolling mechanism is constituted by the gearing section 9, the gearing 11, etc.

[0015] The fixed substrate 2 consists of insulators and the conductor is mostly formed in the rear face on the whole surface. The slot lines 15 and 16 of a couple are formed by removing a part of this conductor circularly. The circular slot lines 15 and 16 share a center on an axis 5, and they are circularly formed so that the ratio of a radius may be set to 3:1. Each point has combined with the slot lines 15 and 16 the above-mentioned input striplines 7 and 8 prepared in the rotation substrate 1, respectively. That is, the input striplines 7 and 8 are set up so that the ratio of length may be set to about 3:1. Specifically, a point is prolonged to the position which deserted the axis 5 rather than the

slot lines 15 and 16 only lambda/4 (wavelength of the electric wave by which electric power is supplied to lambda), and the input striplines 7 and 8 are formed.

[0016] four output striplines 21 combined with the front face of the fixed substrate 2 to each both ends of the slot lines 7 and 8, respectively, and 24; -- 22 and 23 are formed if it furthermore explains to a detail -- the output stripline 21 and 24; -- 22 and 23 lie at right angles [in / an inside position / only in lambda/4] to the slot lines 7 and 8 mostly from each ends of the slot lines 7 and 8 The output striplines 21, 22, 23, and 24 all have equal length.

[0017] Drawing 2 is a cross section for explaining the integrated state of the input stripline 7 formed in the front face of the rotation substrate 1, and the circular slot line 15 formed in the rear face of the fixed substrate 2. The rotation substrate 1 and the fixed substrate 2 are in slide contact, and combination with the input stripline 7 and the circular slot line 15 is attained through the substrates 1 and 2 which consisted of these two insulators. 18 is the conductor formed in the rear face of the fixed substrate 2. In addition, it is the same also about combination with the input stripline 8 and the slot line 16.

[0018] Drawing 3 is the cutting plane line of drawing 1 . III-III It is the cross section which can be set and the composition of the input section 10 for supplying electric power to the input striplines 7 and 8 in a RF signal is shown. The cylinder-like bond-part material 25 is being fixed to the rear face (field which is in slide contact with the fixed substrate 2) of the rotation substrate 1 along with the axis 5, and this bond-part material 25 is electrically connected to the input striplines 7 and 8 through the connection material 26, such as solder. The bond-part material 25 is inserted in free [rotation of the hole 27 formed in the fixed substrate 2], and is further exposed outside from the hole 29 formed in the shielding case 3. The connector 33 for connecting the connector 31 connected to the coaxial cable as a feeder is attached in the marginal part of a hole 29. If outer-conductor 31e of the connector 31 by the side of a coaxial cable is inserted in a connector 33, inner conductor 31i of a connector 31 will enter the building envelope of the cylinder-like bond-part material 25. The gap 35 is formed between inner conductor 31i and the bond-part material 25.

[0019] By this composition, electric power can be supplied to the input striplines 7 and 8 through the bond-part material 25 and the connection material 26 in the RF signal given through a connector 31. And even if the bond-part material 25 rotates with rotation of the rotation substrate 1, since the integrated state of inner conductor 31i of a connector 31 and the bond-part material 25 is held eternally, noise etc. does not produce it at the time of the rotation. Thus, so to speak, the rotary joint is constituted by the cylinder-like bond-part material 25 and inner conductor 31i of a connector 31.

[0020] with the above composition, if electric power is supplied in a RF signal from the input section 10, 2 ****s of this signal will be made the input striplines 7 and 8 -- having -- further -- the slot lines 15 and 16 -- minding -- respectively -- the output stripline 21 and 24; -- 2 ****s is made 22 and 23 As the result, an input RF signal will be used as the outgoing ends E1, E2, E3, and E4 of the output striplines 21, 22, 23, and 24 4 ****s, and will be taken out.

[0021] For example, if rotation operation of the knob 13 is carried out and only an angle theta rotates the rotation substrate 1 counterclockwise, the transmission path length from the input section 10 to outgoing ends E1, E2, E3, and E4 will change as follows. That is, each transmission path length is set up in the shape of a taper. In addition, the radius of

the circular slot line 15 is set to 3r (r is a constant), and the radius of the circular slot line 16 is set to r.

[0022]

E1 ..... -3rthetaE2 ..... - rthetaE3 ..... rthetaE4 ..... The signal which has taper-like phase contrast will be taken out from each [3rtheta, therefore] outgoing ends E1-E4. Since an angle theta can be continuously changed by rotating a knob 13, the phase of the signal taken out from each outgoing ends E1-E4 can be changed continuously, and can also change the phase contrast between signals continuously.

[0023] Next, adjustment of an impedance is explained. Drawing 4 is drawing showing the characteristic impedance of each part. Namely, as for the input striplines 7 and 8, width of face is chosen so that a characteristic impedance may be set to 100 ohms. Moreover, width of face is set up so that a characteristic impedance may be set to 200 ohms, and as for the slot lines 15 and 16, width of face is chosen, as for the output striplines 21, 22, 23, and 24 so that a characteristic impedance may be set to 200 ohms. In this case, the impedance of the input edge A is set to 50 ohms, and each impedance of outgoing ends E1, E2, E3, and E4 is set to 200 ohms, and can take adjustment of an impedance.

[0024] Drawing 5 is drawing simplifying and showing the example of composition for making each impedance of the input edge A and outgoing ends E1-E4 in agreement with 100 ohms. That is, each characteristic impedance of the input striplines 7 and 8, the slot lines 15 and 16, and the output striplines 21, 22, 23, and 24 is set to 100 ohms. And the quadrant wavelength impedance converter of root(50x100) omega is prepared in the section, respectively in the middle of the input striplines 7 and 8. Thereby, the impedance of the input edge A and outgoing ends E1-E4 can be arranged with 100 ohms.

[0025] As shown in drawing 6 , in addition, infix the quadrant wavelength impedance converter of root(50x100) omega in the section in the middle of the slot lines 15 and 16, or Also by infixing the quadrant wavelength impedance converter of root(50x100) omega in the section in the middle of [each] the output striplines 21, 22, 23, and 24, as shown in drawing 7 The impedance of the input edge A and outgoing ends E1-E4 can be made in agreement with 100 ohms. However, in drawing 6 and drawing 7 , the characteristic impedance of each part shall be set up like drawing 5 .

[0026] Furthermore, as simplified and shown in drawing 8 , you may aim at adjustment of an impedance by connecting with the input striplines 7 and 8 and forming the stub 30 as an impedance matching circuit. Although explanation of the example of this invention is as above, this invention is not limited to the above-mentioned example. For example, although the above-mentioned example explained the case where the inputted RF signal was carried out 4 ****s, two distributions, six distributions, and eight distributions are attained, respectively by making into 1, 3, 4, and ..... the input stripline prolonged from an axis 5. In this case, it is [.... What is necessary is to consider as : (2n-1) and just to form in the fixed substrate 2 n circular slot lines combined with these n strip conductors.] the ratio of the length of n striplines About 1:3:5 : At this time, for n circular slot lines, the ratio of a radius is 1:3:5 while sharing a center on an axis 5. : .... It is desirable to be formed so that it may become : (2n-1). If it does in this way, the signal which has taper-like phase contrast can be taken out from the output stripline combined with the both ends of each slot line.

[0027] Moreover, although an input stripline is formed in a rotation substrate and the circular slot line and the output stripline are formed in a fixed substrate in the above-

mentioned example, while forming an input stripline in a fixed substrate, you may form a circular slot line and an output stripline in a rotation substrate. Furthermore, both the 1st substrate in which the input strike RIFFU line was formed, and the 2nd substrate in which the circular slot line etc. was formed are good for mutual also as composition rotated to an opposite direction.

[0028] In addition, design changes various in the range which does not change the summary of this invention can be performed.

[0029]

[Effect of the Invention] Since a distribution adjustable phase shifter can be constituted using a stripline etc. as mentioned above according to this invention, composition becomes easy, and small lightweight-ization can be attained, and manufacture becomes easy. Moreover, since power distribution and a phase shift can be performed with the same composition, part mark decrease compared with carrying out separately, and it is high unreliable. Furthermore, since there is no metal contact, starting a poor contact decreases.

[0030] Moreover, since the number of outputs can be easily changed by changing the number of input striplines, when applying to feeder systems, such as array antennas, it can respond to change of the number of antenna elements flexibly. Furthermore, it is very effective, if a service area is applied to the feeder system of array antennas with the need of changing at any time, like the antenna of a mobile communications base station, for example, since an adjustable setup of the amount of phase shifts of an input signal can be carried out easily.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] this invention relates to the distribution adjustable phase shifter to which the phase of the distributed signal can be changed continuously while being able to perform power distribution of a RF signal. By using this distribution adjustable phase shifter, the beam tilt angle of the array antennas used for example, in a mobile communications base station can be changed electrically.

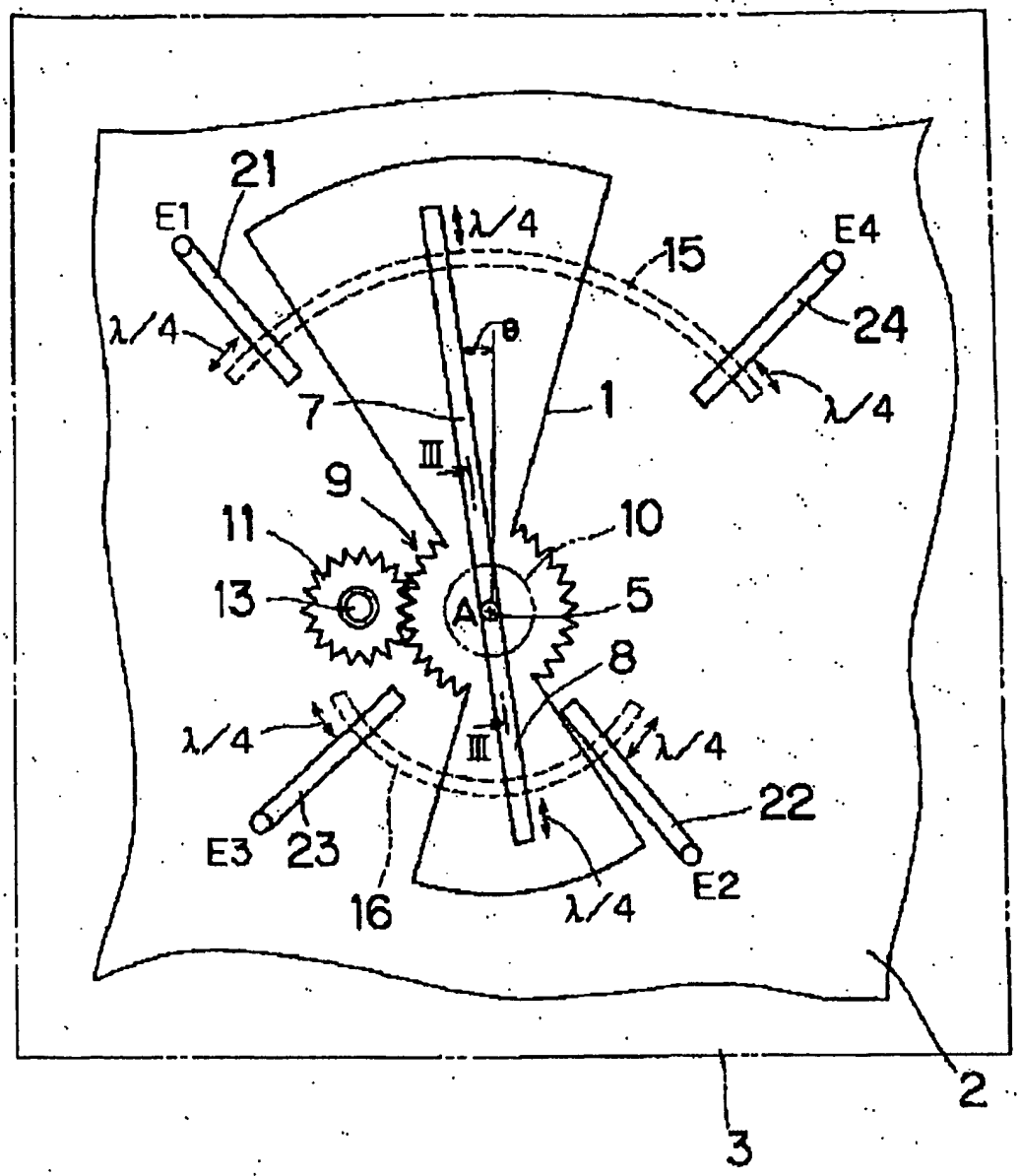
[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the plan showing the composition of the distribution adjustable phase shifter of one example of this invention.
[Drawing 2] It is the cross section showing the integrated state of an input stripline and a slot line.
[Drawing 3] It is the cross section showing the composition of the input section by which electric power is supplied to a RF signal.
[Drawing 4] It is an illustration view for explaining adjustment of an impedance.
[Drawing 5] It is the illustration view showing other examples of composition for taking adjustment of an impedance.
[Drawing 6] It is the illustration view showing the example of composition of further others for taking adjustment of an impedance.
[Drawing 7] It is the illustration view showing the example of composition of further others for taking adjustment of an impedance.
[Drawing 8] It is the illustration view showing the composition which established the impedance matching circuit in the input edge.
[Description of Notations]
1 Rotation Substrate
2 Fixed Substrate
7 Eight Input stripline
15 16 Circular slot line
21, 22, 23, 24 Output stripline

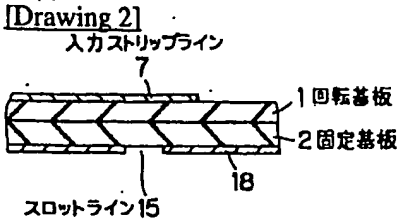
DRAWINGS

[Drawing 1]

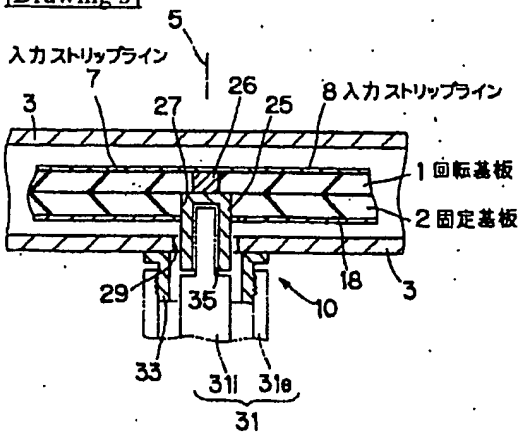


1 …回転基板
2 …固定基板
7,8 …入力ストリップライン
15,16 …スロットライン
21,22,23,24 …出力ストリップライン

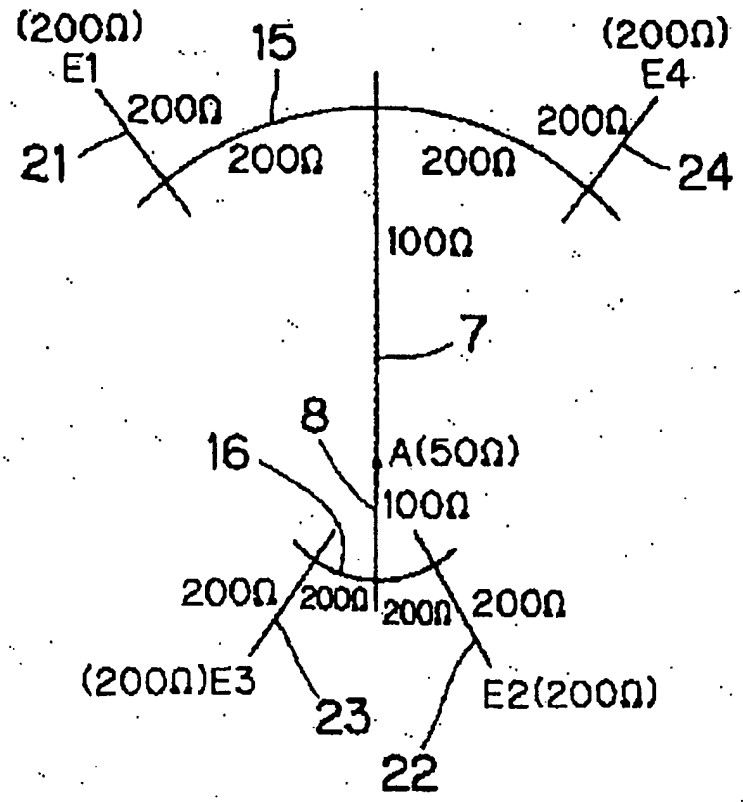
[Drawing 2]



[Drawing 3]



[Drawing 4]

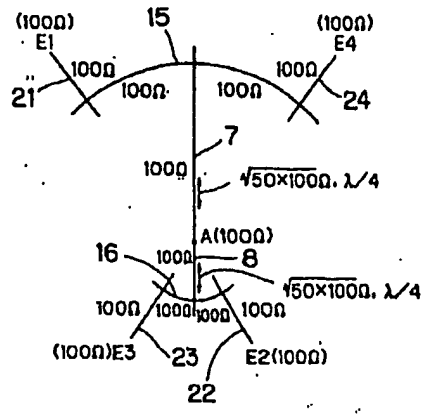


7,8…入力ストリップライン

15,16…スロットライン

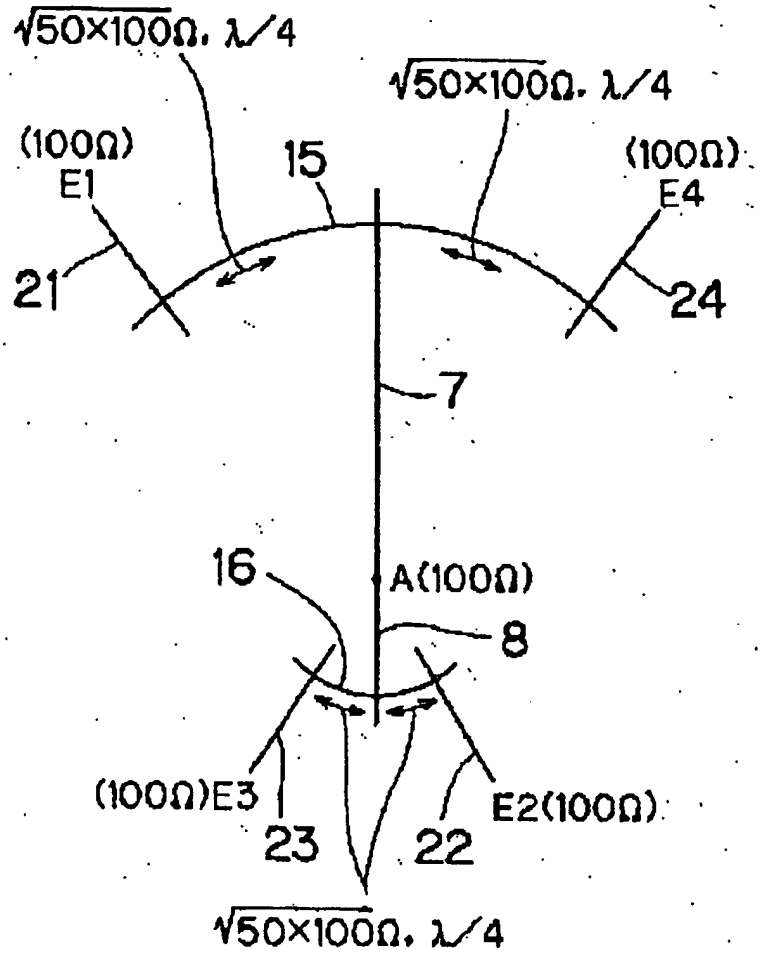
21,22,23,24…出力ストリップライン

[Drawing 5]



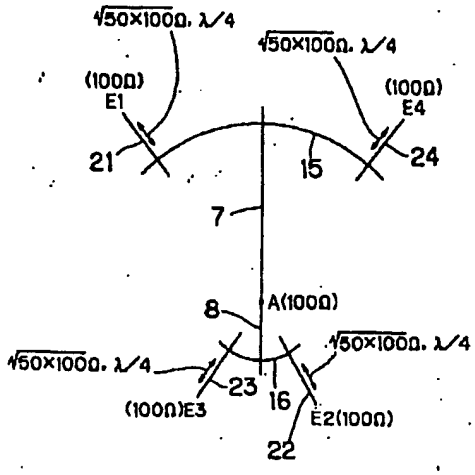
7,8…入力ストリップライン
15,16…スロットライン
21,22,23,24…出力ストリップライン

[Drawing 6]



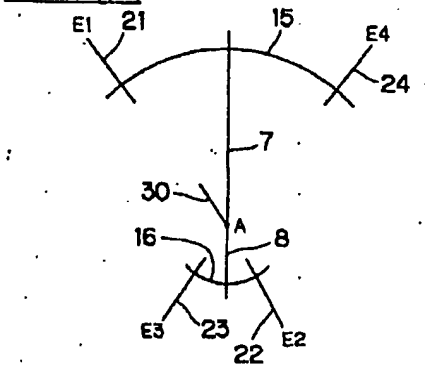
7,8…入力ストリップライン
15,16…スロットライン
21,22,23,24…出力ストリップライン

[Drawing 7]



7,8…入力ストリップライン
15,16…スロットライン
21,22,23,24…出力ストリップライン

[Drawing 8]



7,8…入力ストリップライン
15,16…スロットライン
21,22,23,24…出力ストリップライン

[Translation done.]

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	1/06				
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Ｈ０１Ｑ	3/34		2109－5Ｊ		
	11/04				

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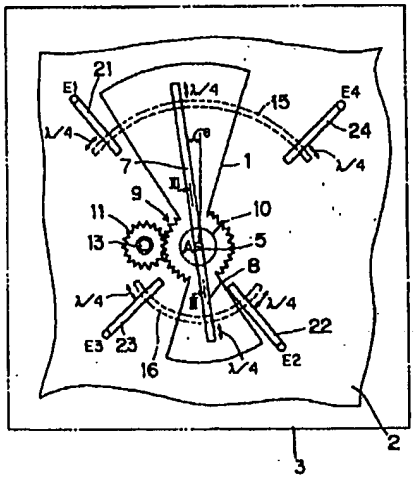
(54)【発明の名称】　分配可変移相器

(57)【要約】

【目的】簡単でかつ信頼性の高い構成により電力の分配が行え、分配された信号の位相を連続的に変化させることができる分配可変移相器を提供する。

【構成】回転基板１は固定基板２に対して相対的に回動可能である。回転基板１には入力端Ａからの高周波信号を２分配する入力ストリップライン７，８が形成されている。固定基板２には、相互に半径の異なる円弧状スロットライン１５，１６が形成されている。これらの各両端には、出力ストリップライン２１，２２，２３，２４が結合させられている。入力端Ａからの高周波信号は出力端Ｅ１～Ｅ４に４分配される。回転基板１を回動させると、入力端Ａから出力端Ｅ１～Ｅ４に至る伝送経路長が連続的に変化する。そのため、移相量が連続的に変化する。また、出力端Ｅ１～Ｅ４からは異なる位相の信号が取り出され、かつ、回転基板１の回動に伴って信号相互間の位相差を変化させることができる。



1…回転基板
2…固定基板
7,8…入力ストリップライン
15,16…スロットライン
21,22,23,24…出力ストリップライン

1

【特許請求の範囲】

【請求項1】所定の軸線まわりに相対的に回動させることができる第1基板および第2基板を有する分配可変移相器であって、

上記第1基板は、上記軸線上に設けられた入力端と、この入力端から分岐したn（n＝1，2，3，4，・・・・）本の入力ストリップラインとを有し、

上記第2基板は、上記n本のストリップラインにそれぞれ結合されているとともに、上記所定の軸線上に中心を共有しているn本の円弧状スロットラインと、このn本の円弧状スロットラインの各両端にそれぞれ結合された2n本の出力ストリップラインとを有することを特徴とする分配可変移相器。

【請求項2】上記n本の円弧状スロットラインは相互に異なる半径を有していることを特徴とする請求項1記載の分配可変位相器。

【請求項3】上記n本の円弧状スロットラインは、半径の比が1：3：5：・・・・・・・：（2n－1）となるように形成されていることを特徴とする請求項2記載の分配可変移相器。

【請求項4】上記入力端と給電線との間を、上記所定の軸線まわりの相対的な回動を許容する状態で結合するロータリジョイントをさらに含むことを特徴とする請求項1乃至3のいずれかに記載の分配可変移相器。

【請求項5】上記第1基板および第2基板を上記所定の軸線まわりに相対的に回動させるための回転機構と、この回転機構に回転力を与えるための操作部とをさらに含むことを特徴とする請求項1乃至4のいずれかに記載の分配可変移相器。

【請求項6】上記入力ストリップライン、上記出力ストリップラインまたは上記円弧状スロットラインにインピーダンス変換器が介装されていることを特徴とする請求項1乃至5のいずれかに記載の分配可変移相器。

【請求項7】上記入力端にインピーダンス整合回路を設けたことを特徴とする請求項1乃至5のいずれかに記載の分配可変移相器。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、高周波信号の電力分配を行えるとともに、分配された信号の位相を連続的に変化させることができる分配可変移相器に関する。この分配可変移相器を用いることにより、たとえば移動通信基地局において用いられるアレイアンテナのビームチルト角を電気的に変化させることができる。

【0002】

【従来の技術】アレイアンテナのビームチルト角を変えるために、電力分配器で分配された高周波信号を各アレイアンテナ素子に給電するケーブルの長さを変え、これによりアレイアンテナに給電される高周波電流の位相分布を変えるようにした給電装置が用いられている。

2

【0003】

【発明が解決しようとする課題】このような給電装置ではケーブルの長さによって高周波信号の移相量が設定されることになるが、たとえば、移相量を変えようとすると、ケーブルをコネクタから取り外し、長さの違うケーブルと交換するかケーブル自体を短縮し、再度コネクタの取付けを行うという煩雑な作業が必要となる。とりわけ、給電装置が屋外に設置される場合には、コネクタ部には防水処理が施されるから、防水処理部の取外しおよび取付けの各作業も行わなければならない。

【0004】また、アレイアンテナのビームチルト角を変えるため、ケーブルの長さを同一とし、電力分配器とアレイアンテナとの間に移相器を介装したものも用いられている。この構成では、位相を連続的にまたは細かなピッチで変化させようとすると、多数のスイッチとケーブルとが必要になり、給電装置の寸法が大きくなるとともに、コストも増大する。しかも、上記スイッチは機械的接点を有しているので、経年変化によって接触不良を起こす可能性があり、相互変調や雑音を生じさせるおそれがある。

【0005】そこで、本発明の目的は、上述の技術的課題を解決し、簡単でかつ信頼性の高い構成により、電力の分配が行えるとともに、分配された信号の位相を連続的に変化させることができる分配可変移相器を提供することである。

【0006】

【課題を解決するための手段および作用】上記の目的を達成するための請求項1記載の分配可変移相器は、所定の軸線まわりに相対的に回動させることができる第1基板および第2基板を有する分配可変移相器であって、上記第1基板は、上記軸線上に設けられた入力端と、この入力端から分岐したn（n＝1，2，3，4，・・・・）本の入力ストリップラインとを有し、上記第2基板は、上記n本のストリップラインにそれぞれ結合されているとともに、上記所定の軸線上に中心を共有しているn本の円弧状スロットラインと、このn本の円弧状スロットラインの各両端にそれぞれ結合された2n本の出力ストリップラインとを有することを特徴とする。

【0007】この構成によれば、第1基板の入力端に高周波信号を与えると、この高周波信号はn本の入力ストリップラインに分配された後に第2基板に形成されたn本の円弧状スロットラインに与えられ、さらに、各円弧状スロットラインの両端に結合している出力ストリップラインに与えられる。これにより、入力された高周波信号は2n分配されることになる。

【0008】第1基板と第2基板とを所定の軸線まわりに相対的に回動させると、入力端から出力ストリップラインに至る伝送経路長は、回動された角度と円弧状スロットラインの半径とに対応して変化する。この伝送経路長に対応して高周波信号の移相量が設定されるから、第

1基板と第2基板とを相対的に回動させることで、移相量を連続的に変化させることができる。

【0009】請求項2記載の分配可変移相器は、上記n本の円弧状スロットラインは相互に異なる半径を有していることを特徴とする。この構成によれば、n本の円弧状ストリップラインは相互に異なる半径を有しているから、第1基板と第2基板との相対的な回動に伴う上記の伝送経路長の変化は、各出力ストリップラインごとに異なる。したがって、2n本の出力ストリップラインから取り出される信号間の位相差を連続的に変化させることができる。

【0010】請求項3記載の分配可変移相器は、上記n本の円弧状スロットラインは、半径の比が1：3：5：……：（2n－1）となるように形成されていることを特徴とする。この構成によれば、第1基板および第2基板の相対的な回動に伴う入力端から各出力ストリップラインに至る伝送経路長の変化量をテーパ状に設定できる。すなわち、入力端に与えられた高周波信号をテーパ状の位相差を有する2n個の信号に分配することができる。

【0011】なお、請求項4に記載されているように、上記入力端と給電線との間を上記所定の軸線まわりの相対的な回動を許容する状態で結合するロータリジョイントを備えることが好ましい。また、請求項5に記載されているように、上記第1基板および第2基板を上記所定の軸線まわりに相対的に回動させるための回転機構と、この回転機構に回転力を与えるための操作部とを備えることが好ましい。

【0012】さらに、入力端と出力ストリップラインの端部の出力端とのインピーダンスを整合させるためには、上記入力ストリップライン、上記出力ストリップラインまたは上記円弧状スロットラインにインピーダンス変換器を介装したり（請求項6）、上記入力端にインピーダンス整合回路を設けたり（請求項7）すればよい。

【0013】

【実施例】以下では、本発明の実施例を、添付図面を参照して詳細に説明する。図1は本発明の一実施例の分配可変移相器の構成を示す平面図である。この分配可変移相器は、第1基板としての回転基板1と、第2基板としての固定基板2とを備えている。固定基板2は仮想線で示すシールドケース3に固定されており、回転基板1は固定基板2に対して所定の軸線5まわりに回動自在であるように取り付けられている。

【0014】回転基板1は絶縁物で構成されており、その表面には、軸線5から離反する方向に延びる入力ストリップライン7，8が形成されている。入力ストリップライン7，8には、固定基板2の背後に設けられた入力部10を介して入力端Aから高周波信号が給電される。回転基板1の裏面には導体は形成されていない。回転基板1は、軸線5の周囲に歯車部9を有している。この歯車部9は、固定基板2に回動自在に保持された歯車11と噛合している。歯車11にはシールドケース3外に突出する操作部としてのノブ13が固定されており、このノブ13を回動させることによって、回転基板1を回動させることができる。すなわち、歯車部9および歯車11などによって回転機構が構成されている。

【0015】固定基板2は絶縁物で構成されており、その裏面にはほぼ全面に導体が形成されている。この導体の一部が円弧状に除去されることによって一対のスロットライン15，16が形成されている。円弧状スロットライン15，16は、軸線5上に中心を共有するもので、半径の比が3：1になるように円弧状に形成されている。回転基板1に設けられた上記の入力ストリップライン7，8は、各先端部がそれぞれスロットライン15，16に結合している。すなわち、入力ストリップライン7，8は、長さの比がほぼ3：1になるように設定されている。具体的には、入力ストリップライン7，8は、先端部がスロットライン15，16よりもλ／4（λは給電される電波の波長）だけ軸線5から離反した位置まで延びて形成されている。

【0016】固定基板2の表面には、スロットライン7，8の各両端部にそれぞれ結合する4本の出力ストリップライン21，24；22，23が形成されている。さらに詳細に説明すると、出力ストリップライン21，24；22，23は、スロットライン7，8の各両端からλ／4だけ内側の位置において、スロットライン7，8とほぼ直交している。出力ストリップライン21，22，23，24はいずれも等しい長さを有している。

【0017】図2は、回転基板1の表面に形成された入力ストリップライン7と固定基板2の裏面に形成された円弧状スロットライン15との結合状態を説明するための断面図である。回転基板1と固定基板2とは摺接しており、この2つの絶縁物で構成された基板1，2を介して入力ストリップライン7と円弧状スロットライン15との結合が達成されている。18は固定基板2の裏面に形成された導体である。なお、入力ストリップライン8とスロットライン16との結合に関しても同様である。

【0018】図3は、図1の切断面線 III－III における断面図であり、入力ストリップライン7，8に高周波信号を給電するための入力部10の構成が示されている。回転基板1の裏面（固定基板2に摺接している面）には、軸線5に沿って円筒状の結合部材25が固定されており、この結合部材25は半田などの接続部材26を介して入力ストリップライン7，8に電気的に接続されている。結合部材25は固定基板2に形成された孔27を回動自在に挿通しており、さらに、シールドケース3に形成された孔29から外部に露出している。孔29の縁部には、給電線としての同軸ケーブルに接続されたコネクタ31を接続させるためのコネクタ33が取り付けられている。同軸ケーブル側のコネクタ31の外部導体